Introduction to the BTeV Project

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Fermilab Internal CD1 Review
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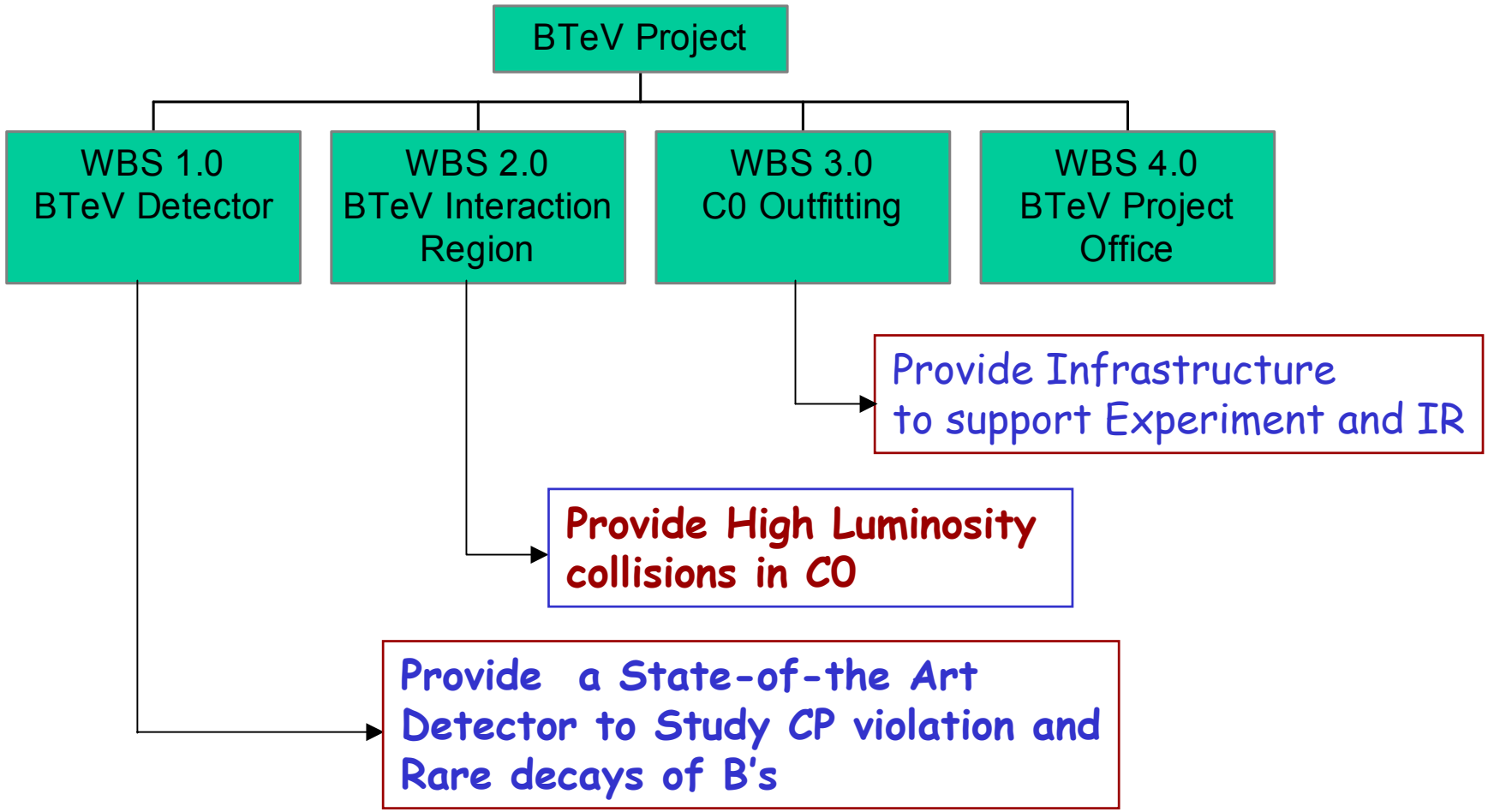
Outline

- The BTeV Project
  - Detector
  - Interaction Region
  - CO Outfitting
  - BTeV Project Office
- Project Organization and Status
- Cost Estimate
- Schedule
- Documentation for the Review
- Summary

Overview

High Level Organization of the BTeV Project

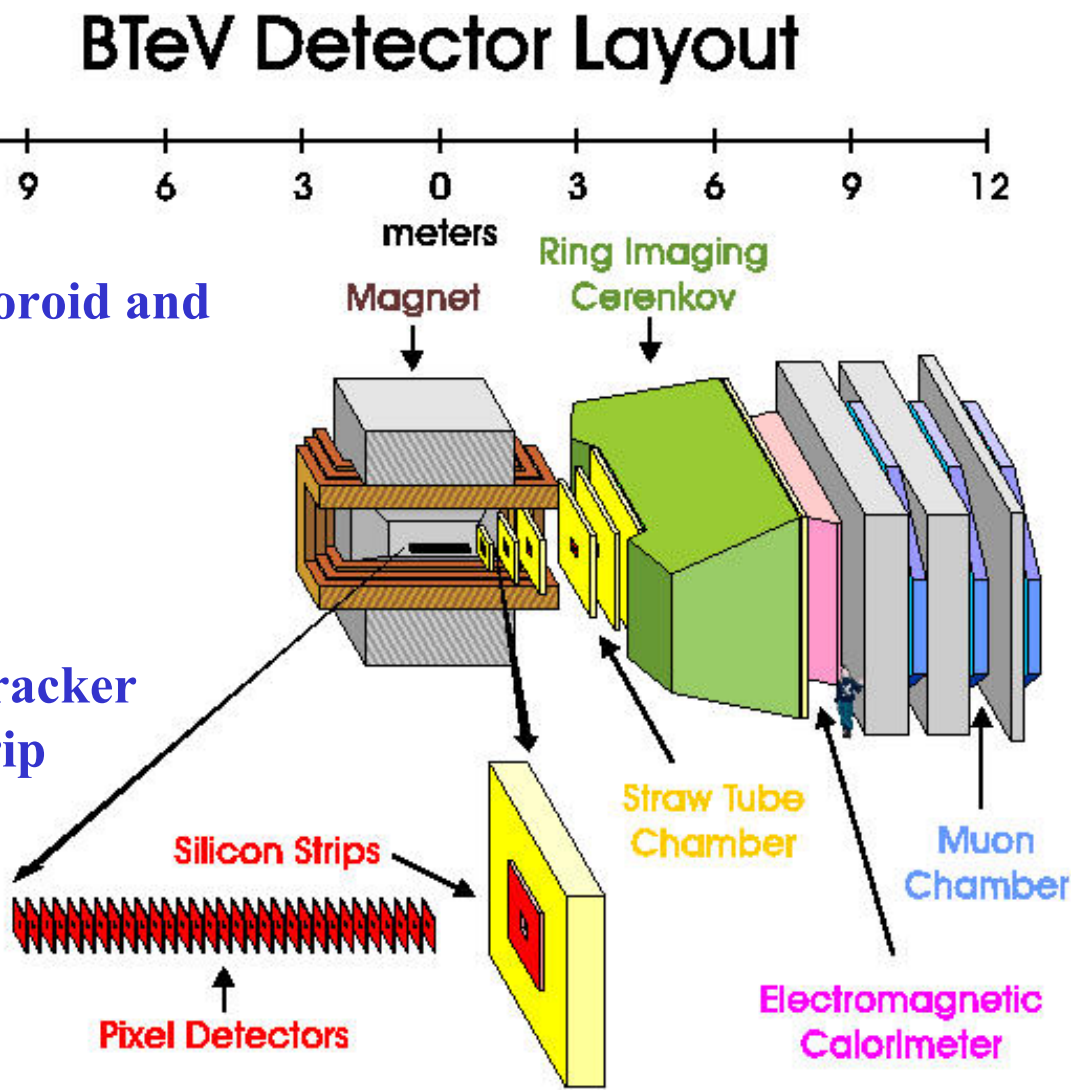


Comment on Status of Subprojects

- The designs of the three subprojects are at different levels technically and in understanding of costs and schedules
  - **The detector has been designed by a large group, starting with a simulation effort in 1996 and then a substantial R&D effort. It has a nearly complete technical baseline.**
  - **The IR has had some design effort, but much of it was directed to eliminate various partial solutions that used "spare" components or components recycled from the existing D0 and/or CDF components. The lab has recently decided to implement a "custom IR" based on new magnets. The P5 recommendations support this. This part of the project requires design of a new low-β insertion and the construction and installation of the components. It has progressed rapidly and is past the conceptual design level**
  - **The C0 Collision Hall and Assembly Area was built in 1999-2000, but was not outfitted to support a large experiment. This project will complete the counting rooms, provide power and cooling required for BTeV and the IR, etc. It is past the conceptual design level and is ready for detailed engineering.**

Work Breakdown Structure - Detector

- 1.1 Vertex Magnet, Toroid and Beam Pipe
- 1.2 Pixel Detector
- 1.3 RICH
- 1.4 EMCAL
- 1.5 Muon Detector
- 1.6 Forward Straw Tracker
- 1.7 Forward Microstrip tracker
- 1.8 Trigger
- 1.9 Data Acquisition
- 1.10 Integration



Detector Technical Status

- We have had a highly efficient, lean and mean, R&D program which is succeeding on all fronts
- The BTeV Detector design has been quite stable for several years. We have changed the design of the pixel support, cooling, and vacuum systems following the recommendations of previous reviews.
- No "gotcha"s. Many "plans" in 2000/2001/2002 are well on their way to realization today. **Test beam work at Fermilab is beginning again.We have a very successful test beam program at IHEP/Protvino**
- We have a DRAFT Technical Design Report that is close to completion and will be the technical baseline for the detector.

Interaction Region

- The quadrupoles that focus the beams at the IP are farther away than for CDF and D0 so optics based on their components only gets 0.32 as much luminosity as at B0/D0
- **A custom design, based on LHC quadrupoles, can raise this to the SAME luminosity as CDF and D0. This approach was recommended by the P5 Subpanel of HEPAP and is now chosen as the baseline plan. Even with lower expectations for Tevatron luminosity, this will ensure that BTeV has its desired luminosity.**
- Significant design work has been done and a Advanced CDR has been written. A list of elements that must be built has been prepared and is the basis of a cost estimate and schedule.

IR and C0: Current Status

- Mike Church, Accelerator Division,is in charge of IR subproject. Jim Kerby of the Technical Division is in charge of Magnet Production part.
- Tom Lackowski of FESS is in charge of C0 Outfitting
- Each project has a WBS and is working on a cost estimate and schedule
- An Advanced Conceptual Design Report has been completed for each
- Internal Review of the IR was held on Feb 18, 19

This design produces a β^* of 35 cm, same as at B0 and D0. BTeV luminosity will be the same as at B0/D0 when BTeV begins to run in 2009ish.

Results of Internal Review of the IR

- "A conceptual design report (CDR) for the BTeV Interaction Region (IR) has been written. This CDR sets forth the requirements for meeting these requirements. It presents the accelerator physics and beam optics design for the IR and addresses the conceptual design for the superconducting magnets and correctors, and cryogenic systems, vacuum systems, controls, and beam instrumentation required to support the new BTeV low beta interaction region. **The conceptual design is judged to be a reasonable basis for proceeding to the more detailed design for the IR."**
- **"The accelerator physics design has progressed to the stage that it can be "frozen" and considered the basis for component selection and component design decisions. Additional work on tracking is desirable"**

IR Issues

- The plan is to use modified LHC quadrupoles because they are the elements we have the most recent experience with at FNAL.
- They need to run at 4.5° K rather than the design 1.9° K.
- The cryostat will be reduced in diameter so the magnet doesn't intersect the tunnel floor. Some work has already been done on this.
- The corrector package design and power leads are still design issues.

C0 Outfitting

- Site Construction: hardstands, utility pads, gas shed,…
- Mezzanine construction: walls, roofing, flooring, finishes (painting, carpeting), computer floor for counting room
- Elevators
- Cooling and HVAC: LCW, Chillers, Computer room cooling, Natural Gas
- Plumbing
- Electrical: lighting, substations, emergency generator, feeders
- Fire Detection

This subproject has an Advanced CDR and a project team, including an engineer. It is divided into 3 phases for budgetary reasons, but in a manner that always provides the access and facilities needed to carry out detector and IR related activities in the C0 area.

Project Office and Level 2 Project Staffing

- **Project Office**
- Project Directors:Joel Butler, Sheldon Stone
- Project Manager: about TBD
- Scheduler: Bill Freeman
- Budget Officer: hiring
- Project Electronic Engineer:Ed Barsotti
- Project Mechanical Engineer: Joe Howell
- Project Software Engineer: Margaret Votava
- Consultant: Bob Downing
- Integration Physicist (TBD)
- Administrative Support: Lory Curry

- **Level 2 Project Managers**
- 1.1 Chuck Brown
- 1.2 Simon Kwan
- 1.3 Marina Artuso
- 1.4 Yuichi Kubota
- 1.5 Paul Sheldon
- 1.6 Alan Hahn
- 1.7 Luigi Moroni
- 1.8 Erik Gottschalk
- 1.9 Klaus Honscheid, Margaret Votava
- 1.10 Joe Howell
- 2.0 Mike Church
- 3.0 Tom Lackowski

Most Level 3 Managers are also in place

BTeV Resource Loaded Cost and Schedule

- The project is being managed using an integrated suite of project management software from WELCOM, inc.– Open Plan (scheduler), COBRA, and WelcomHome.
- The cost estimate is derived from a complete, task-oriented WBS. Realistic assumptions are made about the production model. We have worked hard to include integration activities in a complete and consistent manner
- Estimate starts in FY2005, when we "hopefully" become a construction project. IT IS IN FY2005 DOLLARS.
- Includes contingency, labor rates for all institutions including Fermilab, overhead on labor.
- Overhead on M&S varies according to who places each purchase order and how purchase orders and contracts are aggregated. We provide an estimate based on a specific model that we have discussed with lab management to complete the cost estimate.

Inclusiveness of Detector Cost Estimate

- Cost Estimate Includes
  - All detectors and sensors
  - All mechanical supports
  - All front end electronics
  - All electronics support systems and infrastructure -- high voltage, low voltage, relay racks, etc
  - All associated systems -- gas, cooling, etc.
  - All slow control, monitoring, calibration and alignment systems
  - All development costs, including adequate numbers of prototyping cycles
  - All test stands, test equipment, and production related quality assurance costs
  - Details of transportation, assembly,installaton, integration, and commissioning (project + WBS 1.10)
  - All software and databases required throughout the project
  - ES&H
  - Project Management

Contingency

- We have done a bottoms up estimate based on a consistent methodology for M&S and labor and arrived at a contingency of about 36%. We believe this is reasonable because
  - BTeV detector is a new device but many pieces of it are detectors that have been or are being built, so some parts can have relatively low contingency.
    - Our Cost Estimate is unusually complete for this stage in the project. In many cases, we are dealing with known vendors and have solid quotes
    - The scope has been stable for several years
    - There are parts that use new or unproven technologies and those have much higher contingencies
  - The IR is just starting to acquire quotes from vendors so it has a higher contingency
  - The group that will build the detector exists and has been functioning for several years and has met or exceeded its R&D goals with budgets that were less than expected
  - BTeV Detectors are more decoupled from each other than in central collider detectors and this simplifies installation and integration

CO IR Cost Estimate

The team is in the process of improving the cost estimate There are several issues that cause it to be uncertain:

- **They are beginning to contact potential vendors of IR components to get real quotes on components**
- **Need for optimization and value engineering**
- **Need for a bottoms up Contingency Analysis. At present, there is a 40% contingency assigned to both labor and M&S, which is considered appropriate given the state of the design. This is expected to go down as the design proceeds.**

There are some long-lead time items in this project. They are candidates for "early funding".

Cost and Scheduling Information

- All 10 detector subprojects and the C0 IR and C0 Outfitting have been implemented in OpenPlan. They all have the ability to show all manner of resource profiles.
- We have "linked" the subprojects into a "master project". This allows us to get resource profiles and costs for the whole project.
- OpenPlan calculates the critical paths and detailed floats for each subproject. People are beginning use this to look for scheduling problems. It will take some work to be able to do this for the whole project
- You will be shown some of this work in the various breakout sessions. Because we cannot provide each reviewer with an OpenPlan license or training in using it, we have made some "standard profiles" and provided them to you in PDF format.

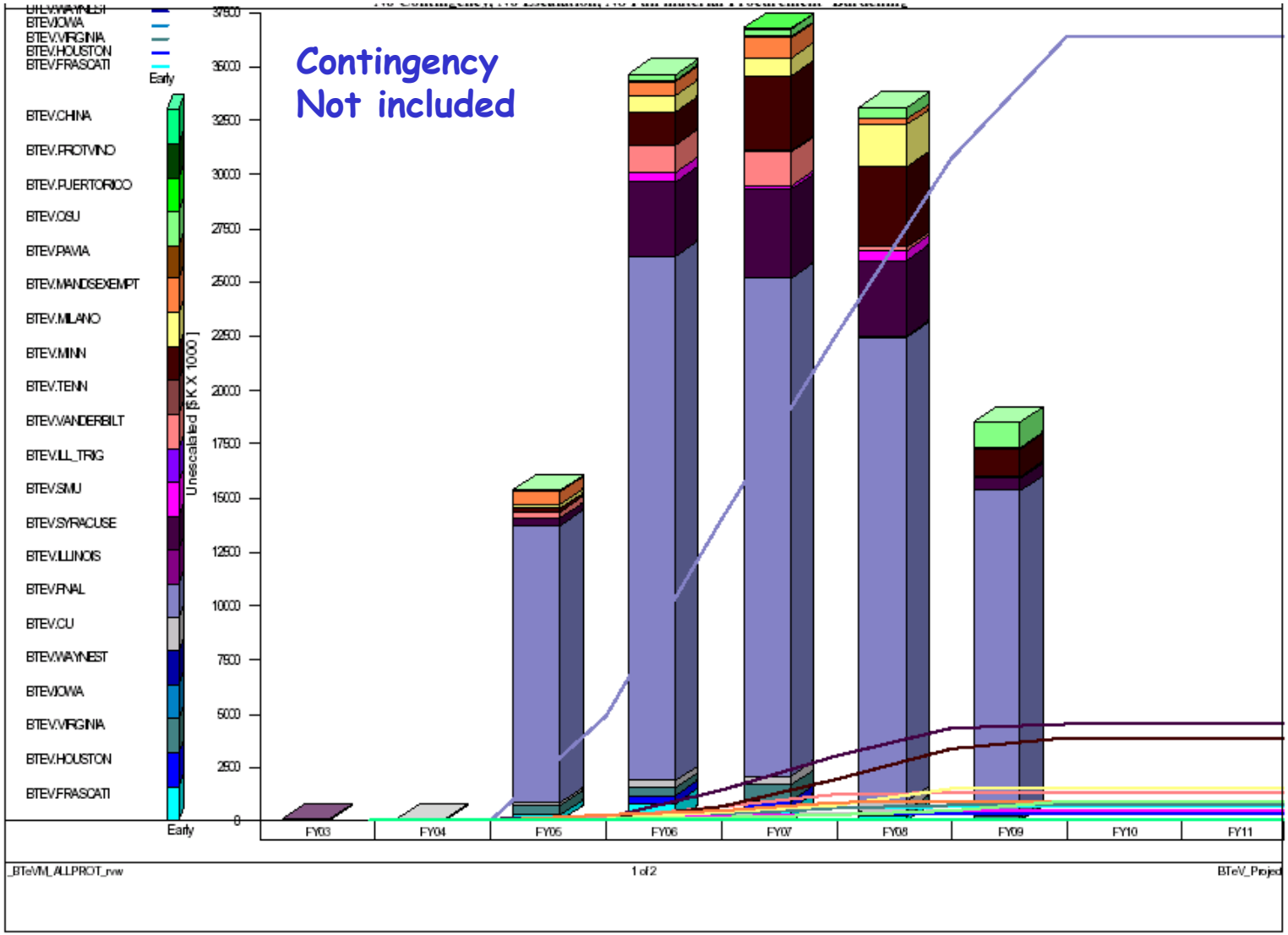
Total Cost (FY05$)

WBS	M&S	Labor	Base	Labor Cont.	M&S Cont.	Total	
1.1	$ 1,306,322	$ 475,978	$ 1,782,300	$ 115,849	$ 331,111	$2,229,261	
1.2	$ 8,057,051	$ 7,448,777	$ 15,505,828	$ 2,729,894	$ 3,394,903	$ 21,630,627	
1.3	$ 9,907,094	$ 2,185,026	$ 12,092,120	$ 598,302	$ 3,754,746	$ 16,445,169	
1.4	$ 10,070,074	$ 2,157,616	$ 12,227,691	$ 577,620	$ 3,494,688	$ 16,300,000	
1.5	$ 2,985,031	$ 977,579	$ 3,962,610	$ 272,231	$ 1,194,877	$ 5,429,719	
1.6	$ 5,289,565	$ 4,238,558	$ 9,528,123	$ 1,387,701	$ 1,382,970	$ 12,298,795	
1.7	$ 3,638,381	$ 3,835,006	$ 7,473,388	$ 1,237,379	$ 1,299,486	$ 10,010,253	
1.8	$ 6,904,653	$ 5,130,889	$ 12,035,543	$ 2,761,727	$ 2,260,480	$ 17,057,752	
1.9	$ 5,070,573	$ 6,964,769	$ 12,035,342	$ 2,021,675	$ 2,040,010	$ 16,097,028	
1.10	$ 1,906,528	$ 4,932,568	$ 6,839,096	$ 3,085,559	$ 407,522	$ 10,332,178	
2.0	$ 19,086,340	$ 11,642,428	$ 30,728,769	$ 7,634,536	$ 4,656,971	$ 43,020,276	
3.0	$ 5,980,763	$ -	$ 5,980,763	$ -	$ 1,196,152	$ 7,176,915	
4.0	$ 582,066	$ 7,411,047	$ 7,993,144	$ 1,748,134	$ 128,133	$ 9,869,382	
Totals	$ 80,784,441	$ 57,400,241	$ 138,184,717	$ 24,170,607	$ 25,542,049	$187,897,355	

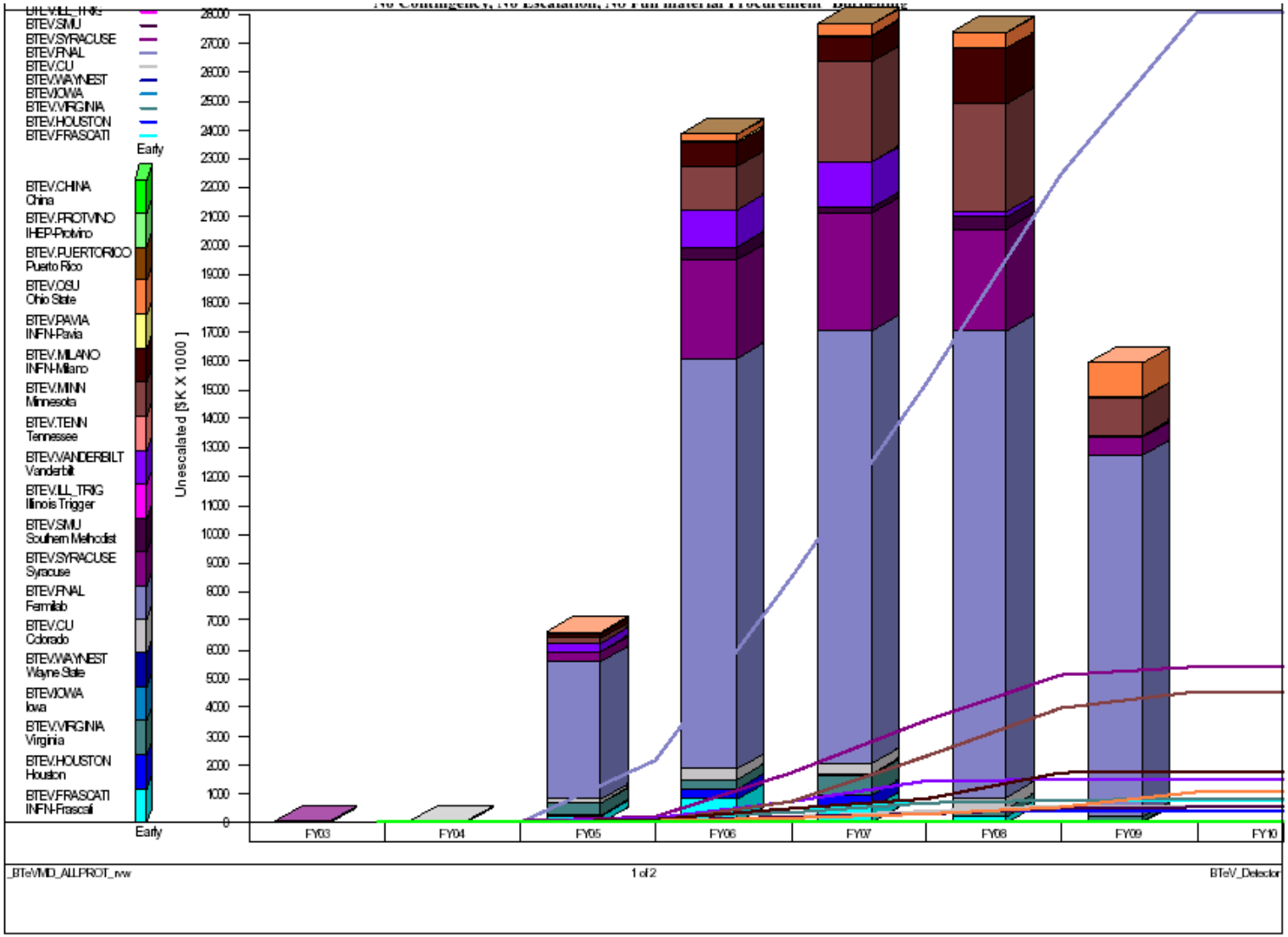
1) Spares included in IR costs

2) Labor for 3.0 appears as M&S (EDIA)

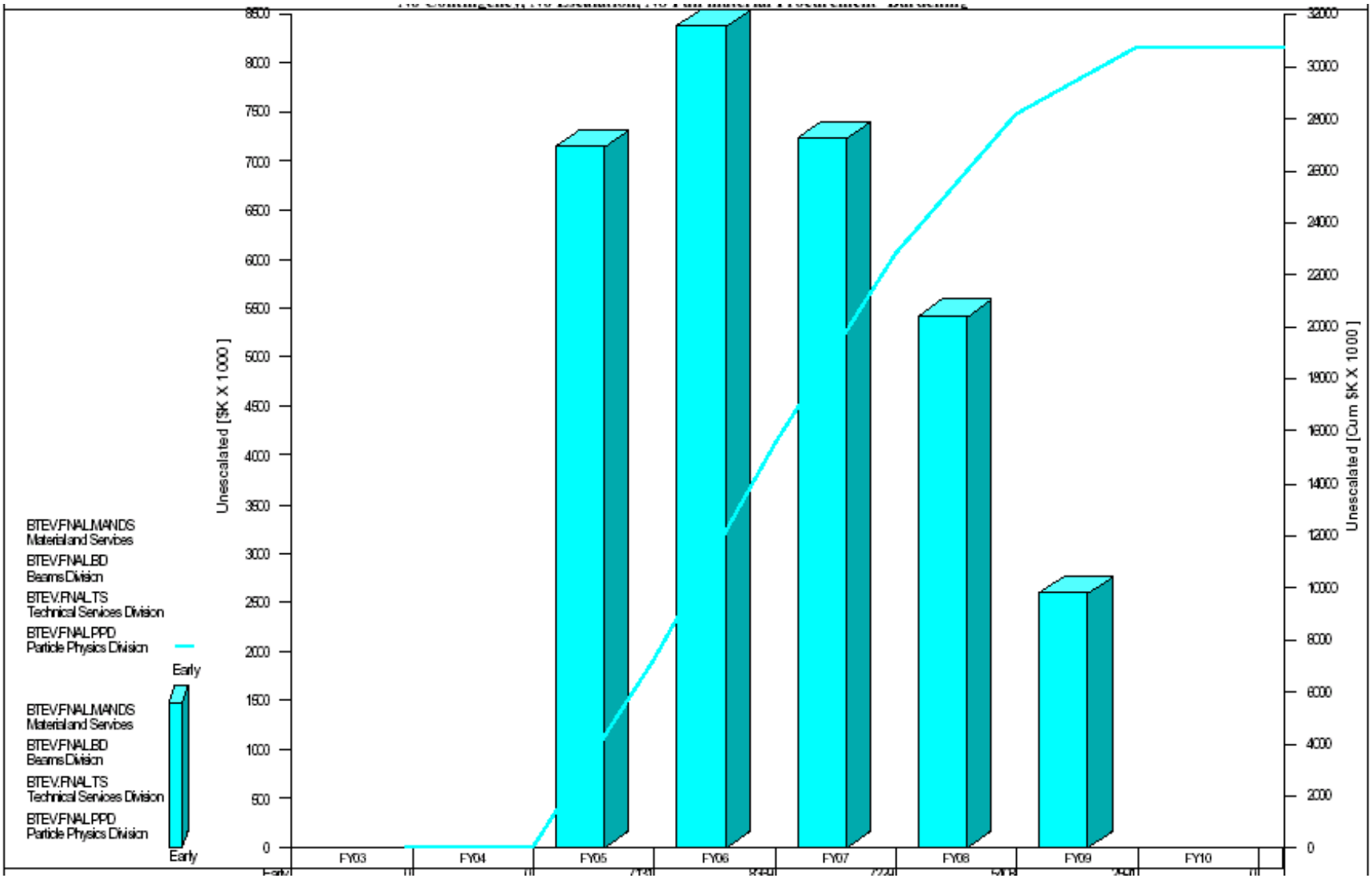
BTeV Project Cost By FY (FY05$)



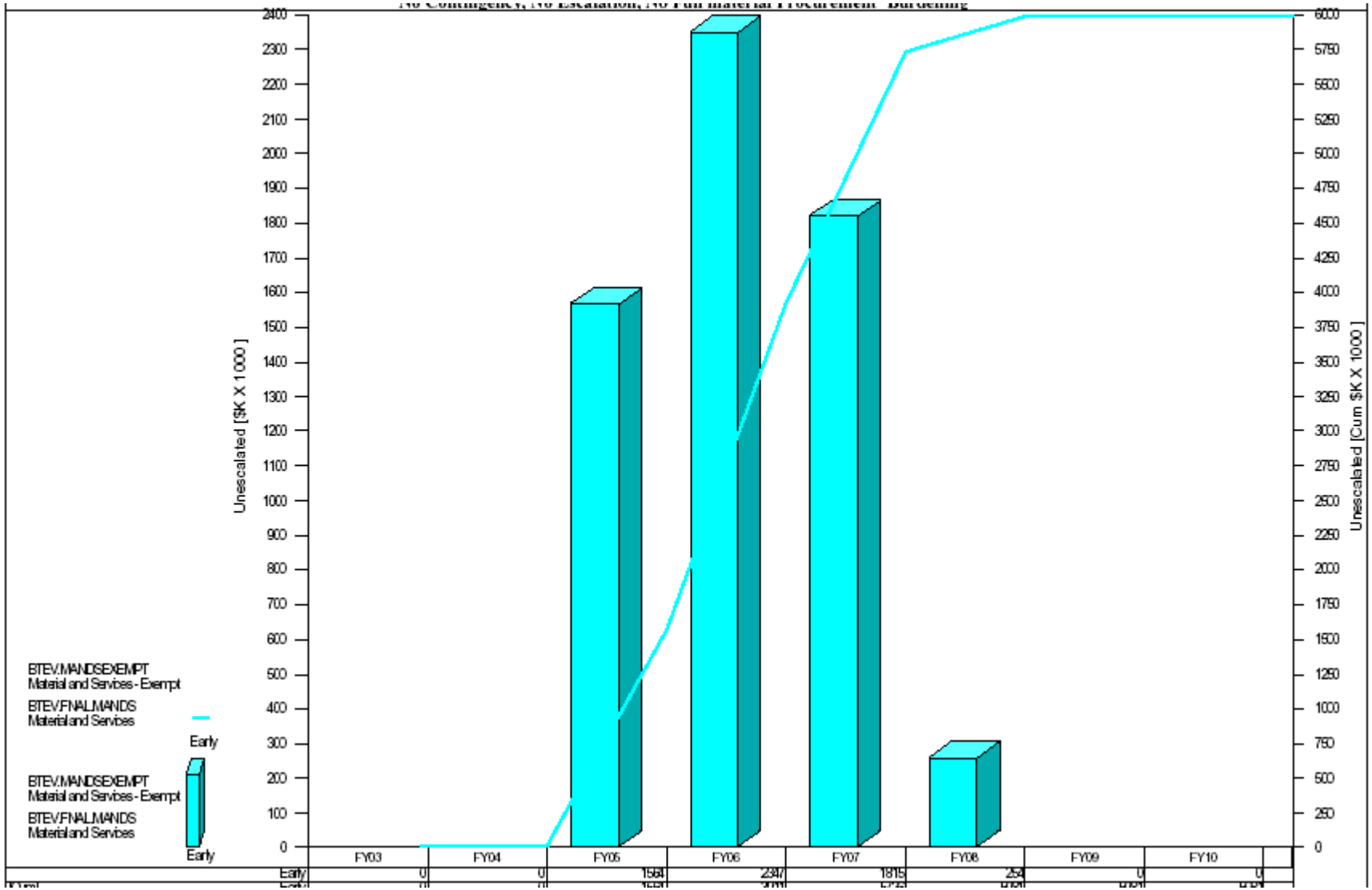
BTeV Detector Cost BY FY (FY05$)



CO IR Cost BY FY (FY05$)



C0 Outfitting Cost BY FY (FY05$)



Lab Funding Profile

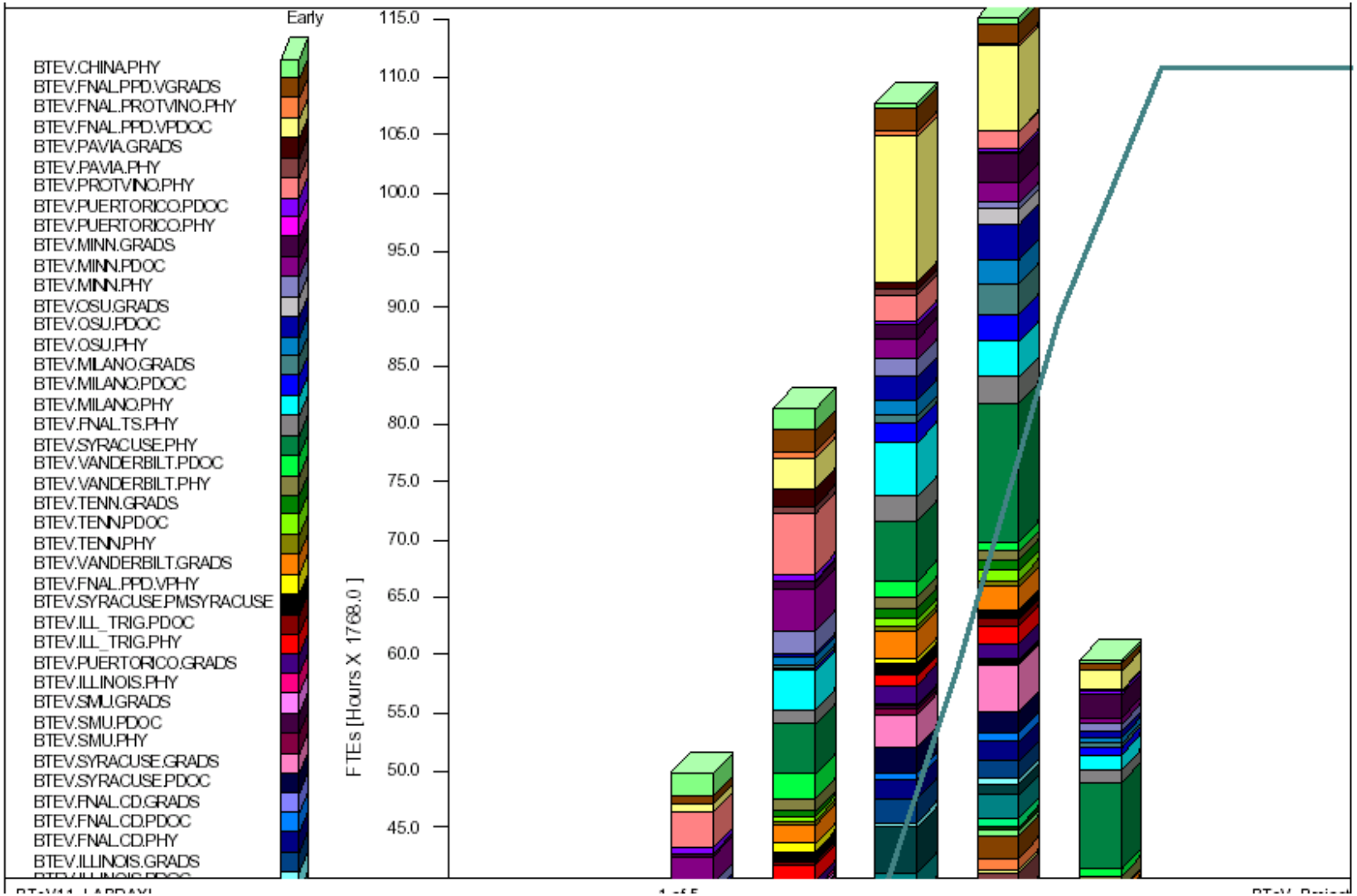
	FY05	FY06	FY07	FY08	FY09	Total
Then-yr	13.1	41.2	51.2	51.7	44.9	202.1
FY05	13.1	40.2	48.6	47.9	39.7	189.5
Cost('05)	20.8	47.0	49.9	45.0	25.2	187.9

We have met the total Cost but have not yet matched the most recent cost profile*

How to cope:

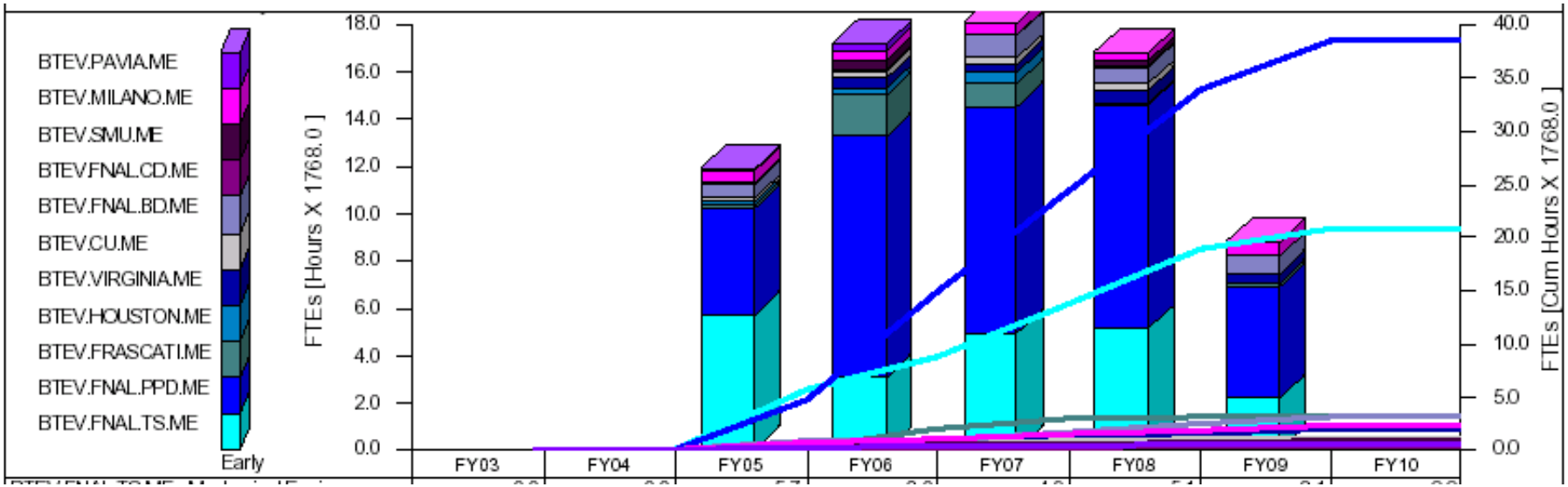
1) Try to shift IR costs to later fiscal years (resolve issue of spares). This was our first attempt.
2) Secure forward funding arrangement with universities and DOE
3) Secure additional funding (reduces total DOE commitment)
   a) INFN
   b) NSF
   c) Other
4) Work on all other aspects of project to try to shift or remove costs

Resource Profile (All Physicists)



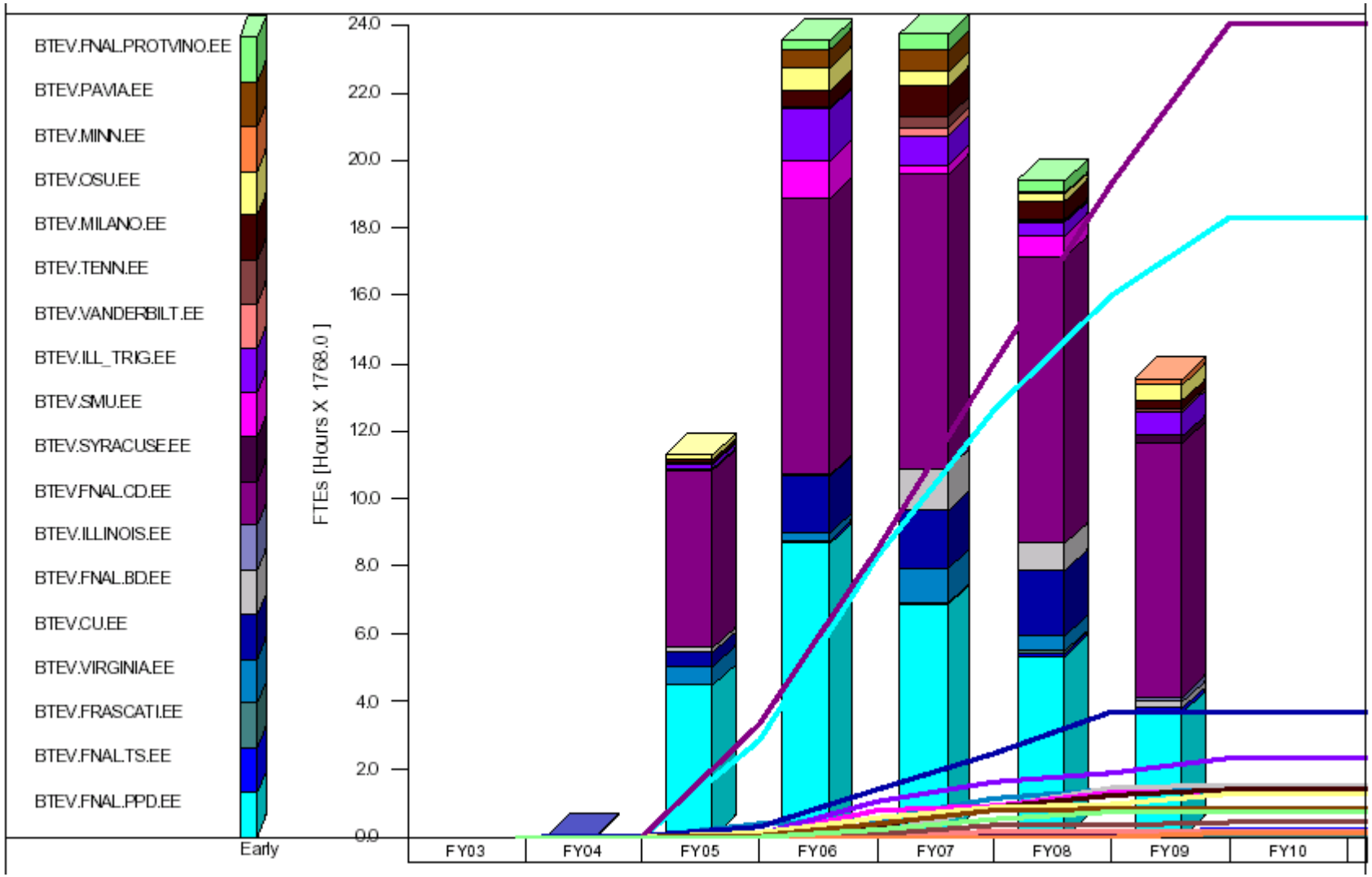
In FTE-yrs-Note suppressed zero, truncated institution list

Resource Profile (All Mechanical Engineers in the BTeV Project)



In FTE-yrs

Resource Profile (All Electrical Engineers in the BTeV Project)



In FTE-yrs

An Integrated Schedule

- Goal: complete the detector in FY 2009 and begin to run.
- This schedule is driven/constrained by
  - Budget
  - Access to Collision Hall: possible only during machine shutdowns for RUN II
  - Interference between the various parts of the BTeV Project itself
  - Technical considerations (practical rate at which things can be done)
- Because of the open architecture of BTeV, we have a plan in which we install the key infrastructure of the experiment - magnets, toroids, and beampipes - by 2007. Then, we can install components of many detectors during short shutdowns and commission them before the long shutdown to finish the installation in 2009
- This should help us come on very quickly in 2009.

Staged Installation/ Rolling Startup

- **Trigger and DAQ will be completed last because it makes sense to wait on items whose price is falling with time**
  - **We will have enough capacity, ~10%, to support detector testing in 2007**
  - **We will have 25% of the full trigger and DAQ in 2008**
  - **We will complete the system in 2009**
- **Detector**
  - **We will have a 10% pixel system operational in 2007 and the full detector ready for installation in early calendar 2009**
  - **We will have significant portions of the forward straw detector in 2007 and 2008**
  - **We will have the Muon system fully assembled and the RICH partially assembled in 2008**
  - **We will have 2/3 of the EMCAL assembled in 2008, with completion in 2009**

BTeV Integrated Schedule (Abbreviated)

Period	Collision Hall Activity	Assembly Hall Activity	Counting Room Activity	C0 Tunnel IR Activity	C0 Service Bldg. &
2005 Shutdown Aug 8-Sep 30	Remove MI Dipoles and Install 4" beam pipe	Modify LCW headers		Remove MI Dipoles , Install new synch Light	Inspect,repack Feeders, Manholes from KRS to B4
Fall 2005 - Summer 2006		Install power for magnet Assemble Vertex Magnet, So. Toroid	Install structural and floors		
2006 Shutdown (Aug 7-Sept 29)	Install Vertex Magnet, Install South Toroid			Remove Q1 magnets and P spools from A4/B1 ; Begin installing low Beta quad bus in tunnel (B4,C1)	
Fall 2006 - Summer 2007		Assemble No. Toroid, RICH tank	Install ground plane, raised floor, counting room		C0 service building modifications, transformers
2007 Shutdown (Aug 6-Sept 28)	Install North Toroid and Muon, 10% pixel, straws			Continue installation of low Beta quad bus in tunnel (B4,C1)	
Fall 2007 - Summer 2008		Install RICH Mirrors and some PMT's,ECAL frame	Begin installation of counting room rack power and	Legend	
2008 Shutdown (Aug 4-Sept 26)	Install partially filled ECAL frame, RICH tank		Begin installation of HVPS, HV, DAQ, cables,	• WBS 1.0 - Detector ○ WBS 2.0 - IR ❖ WBS 3.0 - C0 Outfitting	
Fall 2008 - Spring 2009		I nstsall more detectors	Begin installing L1 trigger crates and DAQ i		
2009 Shutdown (June 1-Sept 3 0	Install full tracking Complete Remain-ing Detectors		Complete installation of trigger and DAQ i	Complete Installation of C0 IR	

Documentation

- Draft TDR for Detector
- Advanced CDRs
  - IR
  - CO Outfitting
- Plenary Session talks
- For each subproject
  - Requirements
  - Participants and group organization
  - Personnel expertise
  - Risk Analysis,Contingency analysis
  - Production, Installation plans
  - Management Plan
  - Breakout Session talks

Management Documents:
Preliminary Project Management Plan
Preliminary Project Execution Plan
Preliminary Acquisition Strategy Plan
Hazard Assessment Plan

- WBS and WBS Dictionary
- Total Construction Costs
- Labor Cost Profile
- M&S Profile
- Large Procurements (>$50K)
- Milestones
- Basis of Estimate and Cost Books

There is a companion CD with The TDR, CDR, Advanced CDRs, many PDFs of Project information from OpenPlan (OBrowser)

Key Points for the review

- We have a technically sound, well-defined project scope that will accomplish our physics goals
- We have a technical design which has been stable for two years and has only a few options, which are about equal in cost. The design meets our stated requirements.
- Our R&D program has gone a long way to reducing risks
- The experiment has less "coupling" than hermetic central collider detectors, resulting in lower costs, fewer uncertainties, ease of assembly and integration
- Our cost estimate is quite complete
- We have taken project risks into account from the start
- We are committed to formal project management techniques
- We have an integrated schedule for the whole BTeV Project that permits us to do early commissioning using end-of-store collisions or wire targets and to begin the experiment in calendar 2009

Final Comments

- We think of the review process as part of the project -- that is, we anticipate receiving good advice on how to improve BTeV.
- We have profited from recommendations and comments of past reviews and expect to do so from this one.
- We thank you for your time and effort and if we can do anything to help you carry out your charge, please let us know.